

ABSTRACT OF THE INVENTION

5 The present invention provides an economical, simple, dry and controllable semiconductor layer junction forming process to make cadmium free high efficiency photovoltaic cells having a first layer comprised primarily of copper indium diselenide having a thin doped copper indium diselenide, n-type region, generated by thermal diffusion with a group II^b(~~a,b~~) element such as zinc, and a ~~group~~ ^{halide} ~~VII~~ element, such as chlorine, and a second layer comprised of a conventional zinc oxide bilayer. A photovoltaic device according the present invention includes a first thin film layer of semiconductor material formed primarily from copper indium diselenide. Doping of the copper indium diselenide with zinc chloride is accomplished using either a zinc chloride solution or a solid zinc chloride material. Thermal diffusion of zinc chloride into the copper indium diselenide upper region creates the thin n-type copper indium diselenide surface. A second thin film layer of semiconductor material comprising zinc oxide is then applied in two layers. The first layer comprises a thin layer of high resistivity zinc oxide. The second relatively thick layer of zinc oxide is doped to exhibit low resistivity.